

Pacific Herring Stocks and Fisheries in the
Arctic-Yukon-Kuskokwim Region
of the Bering Sea,
Alaska, 1999

A Report to the Alaska Board of Fisheries



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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	v
LIST OF FIGURES	vi
INTRODUCTION	1
STOCK STATUS	4
Assessment Methods	4
Spawning Populations	5
Security Cove District	5
Goodnews Bay District	5
Cape Avinof District	6
Nelson Island District	6
Nunivak Island District	7
Central Kuskokwim Bay	7
Cape Romanzof District	7
Norton Sound District	8
Port Clarence District	9
SUBSISTENCE FISHERY	9
COMMERCIAL FISHERY	10
Security Cove District	10
Goodnews Bay District	10
Cape Avinof District	11
Nelson Island District	11
Nunivak Island District	12
Cape Romanzof District	12
Norton Sound District	13
Sac Roe Fishery	13
Spawn on Kelp Fisheries	14
Directed-Bait Fishery	14
Port Clarence District	15
ENFORCEMENT	15
OUTLOOK AND MANAGEMENT STRATEGY FOR 2000	15
Security Cove District	16
Goodnews Bay District	16

TABLE OF CONTENTS (Continued)

	<u>Page</u>
Cape Avinof District.....	16
Nelson Island District.....	17
Nunivak Island District.....	17
Cape Romanzof District.....	18
Norton Sound District.....	18
Port Clarence District.....	19
LITERATURE CITED.....	20

LIST OF FIGURES

	<u>Page</u>
1. Commercial herring fishing districts within the Arctic-Yukon-Kuskokwim Region of the northeastern Bering Sea, Alaska	30
2. Norton Sound commercial herring subdistricts	31
3. Pacific herring run biomass distribution by commercial fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1999	32
4. Pacific herring commercial harvest distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1999	32
5. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999	33
6. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Nunivak Island, Cape Romanzof, and Norton Sound Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999	34
7. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999	35

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Pacific herring harvests by commercial fishermen during the sac roe fisheries in the northeastern Bering Sea, Alaska, 1909-1999.....	21
2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1992-1999	22
3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1992-1999	23
4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1978-1999	24
5. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-1999.....	25
6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1999	26
7. Projections of Pacific herring spawning biomass and harvest guideline for commercial fishing districts in the northeastern Bering Sea, Alaska, 2000	28
8. Herring harvest by gear type and subdistrict, Norton Sound District, 1982-1999.....	29

INTRODUCTION

The objectives of this report are to summarize the results of the 1999 Pacific herring stock assessment programs for the Arctic-Yukon-Kuskokwim (AYK) Region, review 1999 management strategies and harvests in all AYK commercial and subsistence herring fisheries, and present harvest projections and general management strategies for the 2000 fishing season. Commercial fishing districts included in this report consist of the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figures 1 and 2).

The Alaska Board of Fisheries established threshold biomass levels, below which commercial harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060, ADF&G 1998), for all districts with the exception of the Port Clarence District. Exploitation rates are limited to a maximum of 20% in all areas. In some areas, the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests. All AYK herring districts open and close by emergency order authority. The Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries were designated limited entry status in 1987. A moratorium to new entry was placed on the Goodnews Bay herring fishery starting in 1998. In addition, all AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

The Alaska Board of Fisheries approved two new regulations regarding the Norton Sound herring fisheries in November 1998. The open pound spawn on kelp fishery which had been a one year only provisional fishery was made an annual fishery. Similarly, the spawn on wild *Fucus* kelp fishery that was allowed by Emergency Regulation in 1998 was put into regulation. Both these fisheries require participants to own a Norton Sound sac roe permit. The intent is to allow fishers to diversify their use of the herring resource by electing to participate in only one of the fisheries. This would allow permit holders to maximize their earnings by selling their product to the highest paying market.

A total biomass of 63,800 tons of herring was estimated to have been present in the surveyed portion of the AYK Region herring districts in 1999 (Tables 2 and 5). The 1999 return was 11% below the 5-year average (1994-1998) of 71,848 tons. Young herring (ages 5 or less) averaged approximately 4% of the biomass in the region. Middle-aged herring (ages 6-8) comprised approximately one-third of the biomass in all herring districts combined. Older herring (ages 9 and older) constituted almost two-thirds of the biomass in the region. Ages 9 and 10 were the dominant age groups in nearly all the Kuskokwim herring districts (Security Cove, Goodnews Bay, Nelson Island and Nunivak Island). Ages 6 and 9 dominated the herring biomass in the Cape Avinof District. Ages 9 and 11 were the dominant age groups in the Cape Romanzof District. Ages 6 and 11 dominated the herring biomass in the Norton Sound District. The average age among all herring districts was 8.4 years. Cape Avinof had the youngest average age (7.4 years) while Cape Romanzof had the oldest average age (9.2 years). Overall, the recruitment

percentage in number of fish was 8.7%, a record low for the region. DuBois (*in press*) presents information on sampling effort and age composition in 1999.

In recent years, some processors in western Alaska herring fisheries have adjusted delivery weights of the landed catch to reflect water weight. There is considerable variation throughout the fleet in equipment and technique used to handle fish delivered to tenders. Newly implemented dewatering equipment used by some tenders has resulted in lower harvest weights on fish tickets compared to recent years. For the 1999 season, the Alaska Department of Fish and Game, Division of Commercial Fisheries issued a newly designed fish ticket that includes a check box where tender boat operators can record the type of weight used. However, the older fish tickets were widely used in 1999. Norton Sound management staff interviewed processors postseason to determine which tenders or processors used dewatering equipment and which weight-type was recorded on fish tickets. The 'dry' weights recorded on some fish tickets in 1999 were then converted to a 'wet' weight to maintain consistency in harvest reporting and estimated exploitation rate. The converted wet weight is used in the text with the fish ticket weight in parentheses, for the Norton Sound District. Only the fish ticket weight is reported for the other districts.

The 1999 herring harvest for the AYK Region was approximately 7,630 tons, a slight increase from the 1998 harvest of 7,310 tons (Table 1). The 1999 harvest is 10% below the 5-year average (1994-1998) of 8,450 tons. Food and bait sales during the sac roe fishery totaled 412 tons and 8 tons of waste were reported, with the remaining harvest sold as sac roe product (Table 2). Harvest identified as food and bait primarily occurs during the sac roe fisheries when fish are sold with a roe content that is below buyer's acceptable minimums. An additional eight tons of bait were harvested in the directed-bait fishery in the Norton Sound District. In some years, wastage occurs when fishermen abandon gillnets or cannot sell their catch. This amount is added to the total harvest and is included in calculations of exploitation rates. The 1999 total exploitation rate for the AYK Region was 12.0%. Exploitation rates ranged from 8.0% in the Norton Sound District to 20.5% in the Nelson Island District (Table 2).

An awareness among processors, managers and fishermen of poor market conditions and the need for a high-quality product has helped produce high roe percentages in recent years. Roe recoveries in the sac roe harvest ranged from 10.2% in the Cape Romanzof District to 11.3% in the Goodnews Bay District, with a combined regional roe recovery of 10.9% (Table 2).

The 1999 estimated ex-vessel value for the AYK Region of \$1,996,000 was an increase compared to the 1998 value of \$1,158,000 (Table 2). The 1999 value is 50% of the 5-year average (1994-1998) of \$4,021,000, and approximately one-fifth the record value of \$8,730,000 in 1996. The primary reason for the increase in value from 1998 was the improving market for herring in 1999. The price paid to fishermen for herring with 10% roe content in the Kuskokwim Area and Cape Romanzof District ranged from \$200 to \$500 per ton. These prices are approximately 50% greater than the prices paid in 1998. The largest fishery in AYK is the Norton Sound District, which has the last sac roe herring fishery to occur along the west coast each year. Low abundance and harvests of herring in some other areas of the state brought the price up as the fisheries progressed to the Bering Sea. The price paid to fishermen in the Norton Sound

District ranged from \$200 to \$250 per ton. This price was three times the price they received in 1998. Still, fewer processors than usual chose to participate in the Norton Sound sac roe herring fishery. This limited the number of participants in the sac roe fishery, only one-third of the permits were fished, and contributed to a decreased harvest rate. A directed-bait herring fishery was allowed in the Nome Subdistrict, Norton Sound District. The price paid during the directed-bait fishery was \$1,500 per ton (\$0.75 per pound).

A total of 571 permit holders participated in AYK sac roe herring fisheries during the 1999 season (Table 3). Most districts showed slight increases in participation compared to 1998. The exception was the Norton Sound District, where the number of permit holders fishing increased 300% from 1998. However, participation in the 1999 Norton Sound fishery is only one-half the 1993-1997 average of 234 fishers. Beach seine fishers did not harvest any herring in the Norton Sound District during the 1999 season. Two fishers participated in the Norton Sound kelp fisheries and one permit holder harvested herring in the directed-bait fishery.

Surveyed subsistence fishermen from selected Yukon River coastal villages harvested approximately 12.5 tons of herring in 1999 (Table 4). No surveys were conducted in the Nelson Island and Nunivak Island villages. These villages have historically harvested approximately 110 tons of herring annually (Pete 1992).

Biomass projections are made for each district using postseason escapement estimates, historical mean rates of survival, current mean weights for each age class and assumed recruitment rates for each age class (Wespestad 1982). The projected 2000 spawning biomass of the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) is 48,141 tons, with an allowable commercial harvest of 9,450 tons (Table 7). This is a decline from the 1999 biomass of 63,800 tons. All districts have projected declines, partly due to natural mortality as the predominant year class ages. These projections do not include age classes, generally age 3, not yet seen in the fishery. Hamner and Bromaghin (1999) discuss projection methods and details of the projections for year 2000.

Variability in survival rates and in aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Observed biomass estimates may be greater than expected if a large numbers of recruit herring arrive in year 2000. Harvest levels may be adjusted inseason according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest strategy, the commercial fishery will not target newly recruited age classes. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches, and spawn deposition observations.

STOCK STATUS

Assessment Methods

The timing of the spawning migration of herring in the northeastern Bering Sea is greatly influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear soon after ice breakup, which generally occurs between late-April and mid-June. Spawning usually begins in the Security Cove District and progresses in a northerly direction. In some areas, spawning may continue as late as July. The run timing during the 1999 season was approximately two weeks later than average due to a late breakup and extensive sea ice.

Aerial survey techniques have been used since 1978 in Bering Sea herring fisheries to estimate herring spawning biomass (Lebida and Whitmore 1985). However, it is often difficult to obtain biomass estimates from aerial surveys in the AYK Region because of poor survey conditions caused by unfavorable weather, ice conditions or turbid water. Herring school surface areas are recorded in 538 ft² relative abundance index (RAI) units. In the AYK Region, RAI units are converted to biomass based on water depth. Because purse seine gear is needed to estimate the conversion factors and purse seine gear is not usually fished in the AYK Region, conversion factors developed in the Togiak District were used. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 1999, 72 aerial surveys totaling 84.1 hours of flight time were flown in the AYK Region: 11 (5.5 hours) in Security Cove, 13 (6.9 hours) in Goodnews Bay, 2 (1.3 hours) in Cape Avinof, 9 (3.5 hours) in Nelson Island, 4 (4.1 hours) in Nunivak Island, 9 (0.6 hours) in Jacksmith Bay, 5 (3.9 hours) in Cape Romanzof, and 19 (58.3 hours) in Norton Sound and Port Clarence combined. Survey conditions were rated as fair or better in 40% of these surveys.

Gillnets are the only legal gear in the AYK Region, with the exception of Norton Sound where a portion of the harvest is generally taken using beach seine gear. However, the beach seine fishery did not take place during the 1999 season. An attempt was made to sample at least 420 herring from each commercial gear type, district or subdistrict per week. The sampling goal for test fish catches was to sample a minimum of 60 herring per day or 420 per week from each district or subdistrict. Herring from test fish and commercial catches were sampled to estimate age, sex, size, and sexual maturity of herring, and to note the occurrence of other schooling fishes, in all but the Security Cove, Nunivak Island and Port Clarence Districts. Security Cove and Nunivak Island age composition summaries were compiled using samples from Goodnews Bay and Nelson Island, respectively. A total of 8,187 herring from commercial gillnet, subsistence beach seine and test catches were sampled during the 1999 fishing season.

In most districts, fishermen, in cooperation with the Department, provided catch samples for roe quality evaluation by industry representatives. Participation by fishermen in collecting samples,

processor evaluation of samples, and the flexibility of fishermen to fish on short notice helped to increase roe recoveries.

Spawning Populations

Security Cove District

Since 1981, biomass estimates in the Security Cove District have ranged from 2,300 tons in 1987 to 8,267 tons in 1981 (Table 5). The herring biomass projected to return to this district in 1999 was 3,060 tons. Between May 8 and May 31, eleven aerial surveys were flown in the district to estimate herring biomass and observe spawning activity. Three of these surveys were flown under acceptable conditions. The largest biomass, 5,261 tons, was observed on May 22. The peak biomass estimate observed on May 22 was used as the biomass estimate for 1999. A total of 14.5 miles of spawn was observed in the district, with peak spawning activity (3.5 miles) observed on May 25.

Due to budget cuts, herring were not sampled from the Security Cove District. Age composition of the Security Cove District biomass was estimated using samples from the Goodnews Bay District. Ages 10 and 9 herring dominated the biomass (19.9% and 17.1%, respectively, Figure 5) Ages 6 and 10 dominated the return in numbers of fish (18.3% and 17.1%, respectively). Age 9 and older herring comprised 57.7% of the biomass. Recruit herring, ages 2-5, represented 5.0% of the returning population (Figure 7).

Goodnews Bay District

Since 1981, biomass estimates in the Goodnews Bay District have ranged from 2,000 tons in 1987 to 6,896 tons in 1999 (Table 5). The herring biomass projected to return to this district in 1999 was 3,009 tons. During the 1999 season, thirteen aerial surveys were flown in the district between May 8 and May 31 to estimate herring biomass and observe spawning activity. Two of these surveys were flown under acceptable conditions. A record high biomass, 6,896 tons, was observed on May 23 and used as the biomass estimate for 1999. Approximately three miles of spawn was observed in the district with the greatest amount (2 miles) observed on May 23.

The Department's test fish crew sampled 790 herring caught with variable-mesh gillnets from May 20 to May 28 for biological data. Ages 10 and 9 herring dominated the biomass (19.8% and 16.9%, respectively, Figure 5). Ages 6 and 10 dominated the return in numbers of fish (18.2% and 17.2%, respectively). Age 9 and older herring comprised 57.4% of the biomass. Recruit herring, ages 2-5, represented 5.0% of the returning population (Figure 7).

Cape Avinof District

Since 1985, biomass estimates in the Cape Avinof District have ranged from 1,225 tons in 1987 to 4,600 tons in 1997 (Table 5). The herring biomass projected to return to this district in 1999 was 3,555 tons. During the 1999 season, two aerial surveys were flown in the district. Neither of these surveys were flown under acceptable conditions. Eleven tons of herring were observed during the second aerial survey flown on June 8. No spawn was observed in either survey. Aerial survey estimates of herring biomass in the Cape Avinof District have been obtained in only three of the past ten years. The area consists of shallow mud flats where turbidity, caused by wind and wave action, often limits visibility. The last year in which the herring biomass was estimated by survey was 1992, when 3,446 tons were observed. In other years, the preseason projection or commercial catch rates have been used to estimate herring biomass. Due to poor aerial survey conditions in 1999, the total biomass present in the district was assessed to be the projected biomass of 3,555 tons.

The Cape Avinof test fish crew sampled 404 herring caught with variable-mesh gillnets from June 5 to June 10 for biological data. Age 6 herring dominated both the biomass (22.0%, Figure 5) and the return in numbers of fish (26.5%). Age 9 and older herring comprised 48.1% of the biomass. Recruit herring represented 17.6% of the returning population (Figure 7).

Nelson Island District

Since 1985, biomass estimates in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). The herring biomass projected to return to this district in 1999 was 5,826 tons. During the 1999 season, nine aerial surveys were flown between May 30 and June 9 to estimate herring biomass and observe spawning activity. Four of these surveys were flown under acceptable conditions. During an aerial survey on June 3, 3,189 tons of herring were observed in the district. The largest biomass, 3,466 tons, was observed on June 9. It is believed these two biomass estimates were separated enough in space and time to represent different groups of fish and were summed to estimate the total biomass present in the district, 6,655 tons. The only spawn observed in the district was on June 8 (2 miles).

Test fishing with variable-mesh gillnets occurred from May 24 through June 10. The crew sampled 1,261 herring caught in variable-mesh gillnets for biological data. Ages 10 and 9 herring dominated the biomass (20.9% and 20.5%, respectively, Figure 5) and the return in numbers of fish (17.7% and 18.6%, respectively). Age 9 and older herring comprised 60.7% of the biomass. Recruit herring represented 9.5% of the spawning population (Figure 7).

Nunivak Island District

Since 1985, biomass estimates in the Nunivak Island District have ranged from 422 tons in 1990 to 6,000 tons in 1986 (Table 5). The herring biomass projected to return to this district in 1999 was 3,319 tons. During the 1999 season, four aerial surveys were flown between May 30 and June 9 to estimate herring biomass and observe spawning activity. Weather hindered the ability to conduct surveys early in the season, but three surveys between June 7 and June 9 were flown under acceptable conditions. The largest biomass, 1,418 tons, was observed on June 8 under fair conditions. The preseason biomass projection of 3,319 tons was used as the biomass estimate for 1999. A total of 14.0 miles of spawn was observed in the district, with peak spawning activity observed on June 9 (5.0 miles).

Due to budget cuts, herring were not sampled from the Nunivak Island District. Age composition of the Nunivak Island herring biomass was estimated using samples from the Nelson Island District. Ages 10 and 9 herring dominated the biomass (20.9% and 20.5%, respectively, Figure 5) and the return in numbers of fish (17.7% and 18.6%, respectively). Age 9 and older herring comprised 60.7% of the biomass. Recruit herring represented 9.5% of the spawning population (Figure 7).

Central Kuskokwim Bay

The Central Kuskokwim Bay area extends from Jacksmith Bay, south of Quinhagak, to the Ishkowik River. No commercial herring fishing districts are located in this area. Nine aerial surveys were flown in this area from May 8 to May 31. All of these surveys were flown under unsatisfactory conditions. The largest biomass, 226 tons, was observed on May 28 under poor conditions.

Cape Romanzof District

Due to excessive water turbidity in the Cape Romanzof area, it is not generally possible to estimate herring biomass using aerial survey techniques. Based on information from limited aerial surveys, test and commercial catches, and spawn deposition, the estimated herring biomass in the Cape Romanzof District has ranged from approximately 3,800 to 7,500 tons since 1981 (Table 5). Five aerial surveys were flown during the 1999 season from May 30 through June 24. The largest biomass, 2,095 tons, was observed on June 8 under fair conditions. The only spawn observed in the district was 2.5 miles on June 8. Based on spawn deposition study results, commercial and test fishery catch rates, herring age composition and the preseason projection, the 1999 biomass of herring in the Cape Romanzof District was estimated to be between 3,300 and 4,300 tons. This is a decrease from the 1998 biomass estimate of between 4,000 and 5,000 tons.

Artificial spawning substrates were located in the same general spawning locations as in 1992 through 1998. Forty platforms were placed just north of the Department's field camp on June 2. Spawn deposited on the substrate was removed and weighed daily at low tide. Daily removal of spawn allowed measurements of new spawn deposition and decreased the problem of spawn loss due to wave action and desiccation. The largest spawn deposition within the study area occurred on June 8 and June 10. The spawn deposition season total index of 3,694 g documented this year was the fourth lowest since the project began in 1992 and was 14% below the five-year average (1993-1996 and 1998) of 4,296 g. However, it is uncertain whether the study area results are indicative of the total spawning biomass within the entire district.

The Department's test fish crew sampled 889 herring caught with variable-mesh gillnets from June 1 to June 15 for biological data. Age 11 herring dominated the return in both biomass (31.0%; Figure 6) and numbers of fish (27.1%). Age 9 and older herring comprised 68.8% of the biomass. Recruit herring represented just 2.8% of the spawning population (Figure 7). The Cape Romanzof District had the oldest average-age herring (9.2 years) of any district in the region.

Norton Sound District

Historically, the primary spawning areas within Norton Sound have been from Stuart Island to Tolstoi Point. Additional spawning areas have been documented along Cape Denbigh and several bedrock outcroppings along the northern shore of Norton Sound between Bald Head and Topkok, especially in years when sea ice has remained in the nearshore areas into June.

In 1999 a late spring and the associated ice floes affected aerial survey biomass estimates. In mid-June the pack ice was concentrated at the entrance to Norton Sound. The herring migration seemed to be more extended than usual. The pack ice gradually dissipated towards the north and west leaving southern Norton Sound ice choked through the end of the fishery. This ice distribution caused a redistribution of spawning locations and herring biomass.

Since 1978, herring biomass estimates in the Norton Sound District have ranged from 5,291 tons in 1978 to 57,974 tons in 1992 (Table 5). During 1999, 19 surveys were flown between May 27 and June 25. Survey conditions were generally fair. Herring were first sighted during an aerial survey on June 9. The peak aerial survey estimate was made on June 19, when 18,067 tons was observed. On June 24, 14,235 tons were observed in Subdistrict 1. Because of the ice distribution, the staff believes a significant portion of the biomass was holding in deep water. The biomass did not migrate to the *Fucus* beds of southern Norton Sound until June 24 as the sea ice finally dissipated. To account for the unusual herring migration, the peak aerial survey of Subdistrict 1 on June 24 was combined with the peak aerial survey observations of the other subdistricts from June 19. These observations combined with the harvests up to June 19 provide a biomass estimate of 34,314 tons. The preseason biomass estimate was 41,169 tons.

Two Department test fish projects were operational during the 1999 season. One crew operated in the northern portion of Norton Sound at Cape Denbigh, and the second crew was stationed in the

southern end of the district at Klikitarik. Test fishing was conducted in the Unalakleet area by staff as time allowed. Test fish crews sampled 2,525 herring caught with variable-mesh gillnets from May 31 through June 24 for biological data. Age 11 herring dominated the return in biomass (26.4%, Figure 6). Age 6 was the largest component in numbers of fish (24.1%). The biomass consisted of 64.1% age 9 and older herring. Recruit herring represented 9.3% of the return in numbers of fish (Figure 7).

Port Clarence District

Generally, it is not possible to survey this district due to the presence of ice, water stain, or poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. A record biomass for this district of 1,652 tons was sighted during an aerial survey in 1992. No surveys were flown in the Port Clarence district during 1999.

SUBSISTENCE FISHERY

Pacific herring are an important component of the diet of residents of many Yukon-Kuskokwim Delta villages. Surveys of subsistence harvests have been conducted annually in Yukon Delta villages and sporadically in Kuskokwim Delta villages since 1975. In the Nelson and Nunivak Island Districts subsistence surveys have been conducted during several years since 1990 by Subsistence Division (Pete 1990, 1991, 1992, 1993). However, no herring subsistence surveys have been conducted in those districts since 1996 (Table 4). Available data suggest that Nelson Island villages harvest approximately 110 tons of herring annually (Pete 1992).

A total of 48 herring were sampled for biological data from a single beach seine subsistence catch in the Nelson Island District. Age 5 herring dominated the subsistence catch (39.0%). The catch consisted of 12.1% age 9 and older herring and 39.0% recruit-aged herring.

A combination of mail-out questionnaires and personal interviews were used to collect subsistence harvest information from Yukon Delta villages of Hooper Bay, Chevak, and Scammon Bay in 1999. Fifty-nine households responded out of a total of 211 households that were mailed questionnaires. Sixty-seven of the households which did not return mail questionnaires were interviewed as well as six others. A total of 132 households were contacted. A subsistence harvest of 12.5 tons was reported to have been taken by 67 fishing families from Yukon Delta villages (Table 4). In addition, 42 families harvested 1,125 pounds of spawn on *Fucus* kelp for subsistence use. The reported harvest is a minimum estimate since not all fishing families were contacted.

COMMERCIAL FISHERY

Security Cove District

The total harvest of 1,072 tons had an average roe content of 11.0% (Tables 1 and 2). There were 56 tons of bait-quality herring delivered and 1 ton of wasted herring. Eight processors purchased herring from 87 permit holders who made 242 deliveries in three periods with nine hours of total fishing time (Tables 3 and 6). The estimated ex-vessel value was \$338,000. The Guideline Harvest Level (GHL) was raised to 1,052 tons based on the May 22 aerial survey estimate of 5,261 tons. The exploitation rate was 20.4%.

On May 25, the first period opened for two hours starting at 3:00 PM. Seventy-six permit holders delivered 293 tons of sac roe quality herring with an average roe content of 10.7%, 39 tons of bait quality herring and 1 ton of wasted herring with unacceptable roe content, primarily due to spawned out fish. The second and third periods both occurred on May 26 with a combined harvest of 739 tons. During the first two periods fishers were allowed to use 100 fathoms of net. Due to high catch rates the allowable gear was restricted to 50 fathoms during the last period.

Due to budget cuts, herring were not sampled from the Security Cove commercial harvest. Samples from the Goodnews Bay commercial catch are used to estimate the age composition of the Security Cove harvest biomass. The largest age class in the harvest biomass was age 10 (22.9%, Figure 5). Age 9 and older herring made up 69.1% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Goodnews Bay District

The total herring harvest was 1,366 tons with an average roe content of 11.3% (Tables 1 and 2). Bait-quality herring accounted for 33 tons of the harvest. Five processors bought herring from 94 permit holders who made 679 deliveries in eight periods with 49 hours total fishing time (Tables 3 and 6). The estimated ex-vessel value was \$301,000. The GHL was raised to 1,379 tons based on the May 23 aerial survey estimate of 6,896 tons. The exploitation rate was 19.8% of the available biomass.

On May 29, the first period began at 5:00 AM for 6 hours. Forty-six permit holders delivered 44 tons of sac roe herring with an average roe content of 10.0% and 5 tons of bait-quality herring. Between 5:00 PM on May 29 and 9:00 PM June 1, the district was reopened seven times for a total of 43 hours of fishing time. Harvests ranged from 5 tons on May 30 when bad weather resulted in low fisher participation, to 496 tons on May 31.

A sample of 427 herring was taken from the commercial catch. The largest age class in the harvest biomass was age 10 (22.9%, Figure 5). Age 9 and older herring made up 69.1% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Cape Avinof District

The total herring harvest was 533 tons with an average roe content of 11.0% (Tables 1 and 2). Bait-quality herring accounted for 18 tons of the harvest. Three processors bought herring from 117 permit holders who made 656 deliveries in nine periods with a total fishing time of 51 hours (Tables 3 and 6). The estimated ex-vessel value was \$185,000. The exploitation rate was 15.0% based on the pre-season biomass projection of 3,555 tons.

On June 11 the first period opened for three hours starting at 7:00 AM. Forty-nine permit holders landed 16 tons of herring with an average roe content of 10.3% and 1 ton of bait-quality herring. Between June 11 and June 15 the district was reopened eight times for a total of 48 hours of fishing time. Catches ranged from 17 tons on June 11 to 123 tons on June 12-13. Average roe contents ranged from 10.0% to 11.5%.

A total of 396 herring were sampled from the commercial catch. Age 9 herring dominated the harvest (23.8%, Figure 5). Age 9 and older herring made up 71.6% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Nelson Island District

The total harvest was 1,366 tons of herring with an average roe content of 11.2% (Tables 1 and 2). There were 97 tons of bait-quality herring delivered and 2 tons of wasted herring. Four processors purchased herring from 94 permit holders who made 483 deliveries in three periods with a total fishing time of 22 hours (Tables 3 and 6). The estimated ex-vessel value was \$430,000. The exploitation rate was 20.5% of the available biomass.

On June 4 the first period opened for nine hours starting at 12:00 PM. The harvest consisted of 357 tons of sac roe quality herring with an average roe content of 10.0%, 48 tons of bait-quality herring and 2 tons of wasted herring. Processor concern over high male content postponed the second period until June 7, when six hours of fishing resulted in a harvest of 422 tons with an average roe content of 11.6%. On June 8 the GHL was raised to 1,200 tons based on a June 7 aerial survey estimate of 2,938 tons and high catch rates during the June 7 fishing period. On June 8 the last commercial period produced 538 tons of herring in seven hours. Gear was restricted to 50 fathoms per boat during the final period.

A total of 423 herring were sampled from the commercial catch. Age 9 was the largest age class, comprising 28.3% of the harvest (Figure 5). Age 9 and older herring made up 71.0% of the catch. Recruit-age herring made up less than 1% of the commercial sample.

Nunivak Island District

There was no commercial herring fishing in the Nunivak Island District in 1999. This was due primarily to the late spring, persistent ice conditions, lack of processor interest and low aerial survey estimates of abundance.

The Nunivak Island Herring Fishermen's Association is requesting that the Alaska Board of Fisheries consider a management plan for the Nunivak Island District that would allow permit holders to form a cooperative for the purpose of chartering a purse seine vessel to harvest herring.

Cape Romanzof District

A total of 533 tons of herring were harvested by 57 fishers in 1999 (Tables 1, 2 and 3). The commercial harvest was 21% below the recent five-year average (1994-1998) of 671 tons. Sac roe comprised 71%, or 378 tons of the harvest. The average sac roe recovery was 10.2%. A total of 155 tons of herring were purchased as bait. Bait herring consisted of deliveries with roe content below 8%, primarily due to high numbers of partially spawned out females during the last four commercial fishing periods. The commercial harvest did not reach the preseason harvest projection of 560 to 740 tons. The commercial fishery consisted of seven fishing periods, between June 5 and June 14 (Table 6). Fishing periods ranged from 1.5 hours to 3.0 hours in duration for a total fishing time of 13.5 hours. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season.

This season there was a problem with the presence of partially spawned out herring in commercial harvests. Partially spawned out herring accounted for 20% to 51% of the test commercial samples taken from June 8 to June 12. During the last few years early test fishing samples have been good and it will be important to be ready to fish closer to the beginning of the herring migration.

The estimated value of the harvest to fishers was \$127,000 (Table 2). Average price for herring sac roe was \$300 per ton at 10% roe recovery, plus \$30 per percent. The bait herring averaged \$71 per ton to fishers. One company purchased herring, represented by one processing vessel and five tenders during the fishery (Table 3).

Fishing effort was slightly above the five-year average (1994-1998) of 55 fishers. Fishing effort increased 40% compared to 1998 levels. Local Alaskan residents (defined as residents of Chevak,

Hooper Bay, and Scammon Bay) accounted for 98% (56 permits) of the effort and 99% (525 tons) of the harvest (Table 2). Fishermen harvested an estimated 14.0% of the available biomass (Table 2).

A total of 576 herring were sampled from the commercial harvest. Age 11 herring dominated the harvest biomass (39.6%, Figure 6). Age 9 and older herring made up 81.8% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Norton Sound District

Because of an anticipated poor market for herring, two herring spawn on kelp fisheries operated during the 1999 season, a herring spawn on imported *Macrocystis* kelp fishery and a herring spawn on wild *Fucus* kelp fishery. In addition, a directed-bait herring fishery was allowed in the Nome Subdistrict.

Sac Roe Fishery

The total harvest during the sac roe fishery was 2,752 tons (fish ticket weight 2,664 tons) of herring with an average roe recovery of 10.5% (Tables 3 and 6). There were 45 tons (fish ticket weight 42 tons) of bait-quality herring. Five tons of wasted herring were observed in abandoned nets after the fishery closed. Since 1981, catches, including waste, have averaged 4,176 tons. Fishers harvested an estimated 8.0% of the available biomass. Only 119 gillnet fishers out of a possible 320 permit holders participated in the fishery (Table 3).

The gillnet fishery was first opened in the eastern Subdistricts 1, 2 and 3 on June 14. Eight additional periods were allowed on a daily basis until June 22 for a total of 101 hours of fishing time (Table 6). Because pack ice was slow to disperse from the southern districts the majority of the harvest occurred in Subdistrict 3 (Table 8). Due to the ice distribution, active fishing only occurred in the southernmost subdistrict on the last three days of fishing, June 20 to June 22.

None of the sac roe was harvested by beach seine (Table 3). Two beach seine openings were allowed on June 18 and June 21 for a total of eight hours of fishing time (Table 6). One beach seine fisher was prepared to fish, but found it difficult to attract a market until the opportunity to harvest high quality herring had past. Six fishers typically participate in the beach seine fishery. Table 8 presents the historical beach seine and gillnet commercial catches in the Norton Sound District.

Four companies were present on the grounds during the season to purchase herring. These four companies registered five processors and 13 tenders to operate in Norton Sound (Table 3). Sea ice delayed the arrival of two of the processors and approximately one-half of the tenders. The

total value of the herring harvest to Norton Sound fishers was \$615,000, approximately 31% of the five-year (1994-1998) average of \$1,972,000.

A total of 448 herring were sampled from the commercial harvest. Age 11 herring dominated the harvest, comprising 35.6% of the catch by weight (Figure 6). Age 9 and older herring represented 88.0% of the catch. Recruit-age herring comprised less than 1% of the harvest.

Spawn on Kelp Fisheries

Permit holders wishing to participate in the *Macrocystis* spawn on kelp open pound fishery were required to register with the Nome Fish and Game office by April 16. The improved market for sac roe herring caused a decline in interest in the *Macrocystis* spawn on kelp fishery. Eight permit holders registered as participants in the second year of the *Macrocystis* fishery. One permit was revoked just prior to the season and another permit holder eventually chose not to deploy kelp. Of the six participants, only two actually harvested product (Table 3). A late spring and the associated ice floes severely complicated the fishery. At least one kelp frame was damaged by ice, and several participants found their access to spawning herring blocked by ice for several days.

The portion of Subdistrict 1 west of Five-Mile Point was closed to spawn on kelp harvest to minimize gear conflicts. The imported kelp was deployed as it arrived beginning May 22. The two permittees harvesting kelp in the open pound fishery harvested a total of 7,482 pounds of imported *Macrocystis* kelp. Although the spawn on kelp product has been processed, the final sales of the spawn on kelp have not been completed and no value figures are available at this time. A single wild kelp four-hour opening was allowed on June 28. The single participant reported the eggs were already eyed and hatched, and no marketable product was found.

Directed-Bait Fishery

A permit holder from Nome requested that a bait fishery be allowed in the Nome Subdistrict. This permit holder was allowed to harvest bait herring since he was fishing in a distant subdistrict (from the sac roe fishery) and there was a harvestable surplus of herring. To date, 8.3 tons of herring have been landed as bait. The bait harvest has been taken for use in the local halibut and crab fisheries. Approximately 16,500 pounds of bait were sold at \$0.75 per pound. The value of the harvest is approximately \$12,000.

Port Clarence District

There has not been a commercial sac roe fishery in the Port Clarence District since 1988 because buyers have not been present in the district. A small bait fishery with a harvest of less than 10 tons occurs in most years. However, there was no bait fishery in Port Clarence in 1999.

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in Security Cove, Goodnews Bay, and Norton Sound Districts this year. Officers were not present in the Cape Avinof, Nelson Island and Cape Romanzof Districts during 1999. Most fishers followed fishery period opening and closing times very well and buyers were timely and accurate with verbal reporting of purchases. However, several fishers in the Cape Romanzof District had their nets in the water after fishing period closures. In year 2000, fishers will be advised to use methods to avoid fishing after a closure. Two FWP officers were involved in Kuskokwim Bay herring fisheries. Enforcement officers utilized one Supercub aircraft and a small helicopter. Details on the number and type of violations observed are not available from FWP at this time. Protection efforts in Norton Sound consisted of two single engine aircraft (two Supercubs on wheels), and a small boat. Personnel consisted of two permanent, full-time FWP officers. Three citations were issued all relating to fishing after the close of the fishing period.

OUTLOOK AND MANAGEMENT STRATEGY FOR 2000

Projections from postseason escapement estimates suggest that the year 2000 spawning biomass for northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be 48,141 tons, with an anticipated allowable harvest of 9,450 tons (Table 7). Hamner and Bromaghin (1999) discuss methods and details of the year 2000 projections. If the return is as expected, a small to moderate reduction in biomass will be observed in all districts. This decline is primarily due to natural mortality as the dominant year classes age.

Variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Therefore, harvest levels may be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest strategy, newly recruited age classes (age 2 through age 5 herring) will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock

abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations. In all districts, the Department will cooperatively work with fishermen and buyers to optimize roe recovery during the 2000 season.

Security Cove District

The year 2000 projected return to the Security Cove District is 3,622 tons. A 20% exploitation rate would result in a harvest of 724 tons (Table 7). Actual catch will depend on inseason abundance assessments. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons, or significant spawning activity is observed. The occurrence and length of fishing periods will depend on stock strength, fishing effort, and spawning activity.

Due to budget cuts, data was not collected from the Security Cove District in 1999. The estimated year 2000 herring age composition was calculated using data from the Goodnews Bay District. Ages 7, 11 and 10 are expected to comprise over one-half the returning biomass (19.1%, 16.9% and 16.4%, respectively). Age 9 and older herring are expected to comprise almost two-thirds of the biomass.

Goodnews Bay District

The management strategy for this district will be similar to that planned for Security Cove. The season will open and close by emergency order when a biomass of 1,200 tons is observed, or significant spawning activity is observed. The year 2000 projected return of herring to the Goodnews Bay District is 4,665 tons. A 20% exploitation rate would result in a harvest of 933 tons (Table 7). Actual catch will depend on inseason abundance assessments.

Ages 7, 11, and 10 herring are expected to dominate the biomass, contributing 19.5%, 16.7%, and 16.3%, respectively. Age 9 and older herring are expected to comprise almost two-thirds of the biomass.

Cape Avinof District

Either significant spawning activity or a biomass of 500 tons must be observed before the commercial herring season can be opened. The projected year 2000 biomass for the Cape Avinof District is 2,868 tons (Table 7). The exploitation rate will be no greater than 15% because of the limited database for this area and the priority of subsistence fishing. Assuming a 15% commercial

exploitation rate, the projected harvest will be 430 tons of herring. Actual catch will depend on inseason abundance assessments.

Ages 7, 10 and 9 are expected to comprise over one-half the returning biomass (28.5%, 14.8% and 12.3%, respectively). Age 9 and older herring are expected to comprise almost one-half of the biomass.

Nelson Island District

In the Bering Sea Herring Fishery Management Plan, the Alaska Board of Fisheries set a minimum biomass threshold of 3,000 tons for the Nelson Island District. The inseason estimate of herring biomass must exceed the threshold level before a commercial fishery can be allowed.

The spawning biomass projected to return to the Nelson Island District in year 2000 is 4,672 tons (Table 7). At an exploitation rate of 20% minus 200 tons for subsistence harvest, the commercial harvest will be 734 tons of herring. Actual catch will depend on inseason abundance assessments.

To provide additional protection for the subsistence harvest of herring, the following guidelines will be followed:

1. Two hundred tons of the exploitable biomass will be set aside for subsistence.
2. Periodic closures of the commercial fishery will be scheduled, during which only subsistence fishing will be allowed.
3. Several important subsistence use areas occur throughout the district, including the waters around Cape Vancouver. Specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.
4. The Department will by all available means, including acting on input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Similar to Goodnews Bay, ages 7, 10 and 11 are expected to dominate the returning population, contributing 19.5%, 18.5%, and 18.2%, respectively. Age 9 and older herring are expected to comprise almost two-thirds of the biomass.

Nunivak Island District

The biomass of herring projected to return to the Nunivak Island District in year 2000 is 2,823 tons. A 20% exploitation rate would result in a 565-ton harvest (Table 7). Actual catch will depend on inseason abundance assessments. A larger catch may occur if the 2000 biomass is assessed to be

greater than projected. The commercial season will open when the biomass reaches 1,500 tons, or when significant spawning is observed.

Due to budget cuts, data was not collected from the Nunivak Island District in 1999. Estimates for year 2000 age composition were calculated using data from the Nelson Island District. Ages 10, 11 and 9 are expected to comprise well over one-half the returning biomass (20.4%, 18.9% and 17.3%, respectively). Age 9 and older herring are expected to contribute over two-thirds of the return.

Cape Romanzof District

The projected return for year 2000, based on limited data, is expected to be between 2,067 and 3,067 tons based on an assessed biomass of between 3,300 and 4,300 tons in 1999. The midpoint of this range for 1999 was 3,800 tons, which results in a projected biomass of 2,567 tons. At a 20% exploitation rate, the harvest based on this projection would be 513 tons (Table 7). The allowable harvest is expected to range from approximately 463 to 563 tons and will be based on inseason indicators of abundance. It is probable that fishing gear will be restricted to no more than 50 fathoms and one gillnet per vessel by emergency order. Since water turbidity in the Cape Romanzof area generally prevents aerial observations of herring, spawn deposition and test and commercial catch rates will be used to determine the timing and duration of commercial fishing periods.

Ages 12, 9, and 10 herring are expected to dominate the biomass, contributing 24.6%, 21.0%, and 20.1%, respectively. Age 9 and older herring are expected to comprise 78.7 % of the return.

Norton Sound District

The biomass projected to return to Norton Sound in year 2000 is 26,924 tons. A 20% exploitation rate would result in a harvest of 5,385 tons (Table 7). Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery, except where weather prevents obtaining an inseason estimate. The beach seine harvest is, by regulation, 10% of the projected harvest, or 538 tons.

The year 2000 herring fishery will be opened by emergency order. The fishery will close by emergency order when up to 20% of the available herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions.

Ages 7, 12 and 9 are expected to comprise well over one-half the returning biomass (23.3%, 22.1% and 13%, respectively). Age 9 and older herring are expected to contribute over two-thirds of the return.

Port Clarence District

The Department does not generally project an outlook for the Port Clarence fishery due to the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons established by the Board of Fisheries in 1981 will determine the allowable harvest in 2000. This harvest guideline is based on two years research by the Department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time.

LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). 1998. Commercial herring fishing regulations, 1998-1999. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Juneau.
- DuBois, L. (*in press*). Age, sex, and size composition of Pacific herring from coastal Bering Sea spawning sites in the Arctic-Yukon-Kuskokwim Region, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, Anchorage.
- Hamner, H.H. and J.F. Bromaghin. (1999). Forecast of stock abundance for 2000 Arctic-Yukon-Kuskokwim Region herring fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, Anchorage.
- Lebida, R.C. and D.C. Whitmore. 1985. Bering Sea Herring Aerial Survey Manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 85-2, Anchorage.
- Pete, Mary C. 1990. Subsistence-Herring Fishing in the Nelson Island and Nunivak Island Districts, 1990. Alaska Department of Fish and Game, Division of Subsistence, Juneau. Technical Paper No. 196.
- Pete, Mary C. 1991. Subsistence-Herring Fishing in the Nelson Island and Nunivak Island Districts, 1991. A Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Subsistence, Juneau.
- Pete, Mary C. 1992. Subsistence-Herring Fishing in the Nelson Island and Nunivak Island Districts, 1992. Alaska Department of Fish and Game, Division of Subsistence, Juneau. Technical Paper No. 221.
- Pete, Mary C. 1993. Subsistence-Herring Fishing in the Nelson Island and Nunivak Island Districts, 1992. Alaska Department of Fish and Game, Division of Subsistence, Juneau. Technical Paper No. 192.
- Wespestad, V.G. 1982. Cohort analysis of catch data on Pacific herring in the eastern Bering Sea, 1959-81. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Technical Memorandum NMFS F/NWC-24, Seattle.

Table 1. Pacific herring harvests by commercial fishermen during the sac roe fisheries in the northeastern Bering Sea, Alaska, 1909-1999.

Year	Herring (st) ^a									Spawn on Kelp (st)
	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound	Port Clarence	Total Harvest	Norton Sound
1909-1916	-	-	-	-	-	-	^b	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-
1929	-	-	-	-	-	-	166	-	166	-
1930	-	-	-	-	-	-	441	-	441	-
1931	-	-	-	-	-	-	86	-	86	-
1932	-	-	-	-	-	-	529	-	529	-
1933	-	-	-	-	-	-	31	-	31	-
1934	-	-	-	-	-	-	4	-	4	-
1935	-	-	-	-	-	-	15	-	15	-
1936	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-
1938	-	-	-	-	-	-	10	-	10	-
1939	-	-	-	-	-	-	6	-	6	-
1940	-	-	-	-	-	-	14	-	14	-
1941	-	-	-	-	-	-	3	-	3	-
1942-1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-
1965	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-
1967	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-
1970	-	-	-	-	-	-	8	-	8	-
1971	-	-	-	-	-	-	20	-	20	-
1972	-	-	-	-	-	-	17	-	17	-
1973	-	-	-	-	-	-	35	-	35	-
1974	-	-	-	-	-	-	2	-	2	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-
1977	-	-	-	-	-	-	11	-	11	<1
1978	286	-	-	-	-	-	15	-	301	4
1979	424	90	-	-	-	-	1,292	-	1,806	13
1980	697	448	-	-	-	611	2,452	-	4,208	24
1981	1,173	657	-	-	-	720	4,371	-	6,921	47
1982	813	486	-	-	-	657	3,933	-	5,889	38
1983	1,073	435	-	-	-	816	4,582	-	6,906	29
1984	335	717	-	-	-	1,185	3,662	-	5,899	19 ^c
1985	733	724	-	977	358	1,299	3,548	-	7,639	-
1986	751	557	-	886	511	1,865	5,194	-	9,764	-
1987	313	321	-	923	414	1,342	4,082	146	7,541	-
1988	324	483	348	775	-	1,119	4,672	80	7,801	-
1989	554	616	129	233	116	926	4,771	-	7,345	-
1990	234	455	50	-	-	329	6,439	-	7,507	-
1991	570	263	267	-	59	526	5,672	-	7,357	-
1992	834	740	451	246	27	530	-	-	2,828	-
1993	5	954	215	739	-	371	5,079	-	7,363	-
1994	-	1,062	427	717	14	456	960	-	3,636	-
1995	1,292	1,054	485	1,113	41	541	6,773	-	11,289	-
1996	1,859	1,204	820	1,030	101	752	6,220	-	11,986	-
1997	892	805	687	778	0	879	3,976	-	8,017	-
1998	1,012	831	656	1,250	202 ^d	727	2,632 ^e	-	7,310	9 ^f
1999	1,072	1,366	533	1,366	-	533	2,760 ^g	-	7,630	4 ^h

a Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage is included.

b Fishery occurred some years but harvest data unavailable.

c Additional 3 st harvested from imported kelp (*Macrocystis* sp.) not included.

d Includes 200 st harvested with purse seine during aerial survey calibration study.

e Includes 8.3 tons harvested during a directed bait fishery.

f Includes 2,100 lbs of wild kelp and 16,083 lbs of *Macrocystis* kelp (preliminary numbers).

g Includes 8.3 tons harvested during a directed bait fishery.

h 7,482 lbs of *Macrocystis* kelp (preliminary numbers).

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1992-1999.

Year	District	Estimated Biomass(st)	Harvest (st)				Total	Roe %	Estimated Value (\$ x 1,000)	Exploitation Rate (%)
			Sac roe	Bait	Waste					
1999	Security Cove	5,261	1,016	56	1	1,072	11.0	338	20.4	
	Goodnews Bay	6,896	1,332	33	0	1,366	11.3	301	19.8	
	Cape Avinof	3,555 ^a	516	18	0	533	11.0	185	15.0	
	Nelson Island	6,655	1,267	97	2	1,366	11.2	430	20.5	
	Nunivak Island ^b	3,319 ^a	-	-	-	-	-	-	-	
	Cape Romanzof	3,800 ^a	378	155	0	533	10.2	127	14.0	
	Norton Sound	34,314	2,702	53	5	2,760	10.5	615 ^c	8.0	
Total		63,800	7,211	412	8	7,630	10.9	1,996	12.0	
1998	Security Cove	4,017 ^a	1,012	0	0	1,012	11.5	232	25.2	
	Goodnews Bay	4,064 ^a	831	0	0	831	11.3	118	20.5	
	Cape Avinof	4,287 ^a	656	0	0	656	11.6	152	15.3	
	Nelson Island	7,136 ^a	1,250	0	0	1,250	11.8	296	17.5	
	Nunivak Island	3,778 ^a	202 ^d	0	0	202	9.8	26 ^e	5.4	
	Cape Romanzof	4,500 ^a	617	110	0	727	10.0	131	16.2	
	Norton Sound	52,033	2,824	8	0	2,832	9.2	203 ^c	5.1	
Total		79,815	7,192	118	0	7,310	10.2	1,158	9.2	
1997	Security Cove	4,640 ^a	884	3	5	892	12.5	221	19.2	
	Goodnews Bay	4,752 ^a	805	0	0	805	14.2	228	16.9	
	Cape Avinof	4,600 ^a	687	0	0	687	11.5	157	14.9	
	Nelson Island	7,900 ^a	778	0	0	778	12.7	198	9.8	
	Nunivak Island	3,801 ^a	0	0	0	0	-	-	0	
	Cape Romanzof	5,000 ^a	879	0	0	879	10.2	186	17.6	
	Norton Sound	47,791	3,709	263	5	3,976	9.9	612	8.3	
Total		78,484	7,742	266	10	8,017	11.1	1,602	10.2	
1996	Security Cove	6,867	1,795	59	5	1,859	11.6	1,251	27.1	
	Goodnews Bay	6,315	1,191	13	0	1,204	12.5	895	19.1	
	Cape Avinof	4,500 ^a	820	0	0	820	13.4	659	18.2	
	Nelson Island	6,638 ^a	986	44	0	1,030	11.4	679	15.5	
	Nunivak Island	4,195 ^a	61	40	0	101	9.9	39	2.4	
	Cape Romanzof	6,000 ^a	750	1	0	752	10.6	638	12.5	
	Norton Sound	27,307 ^a	6,061	109	50	6,220	10.6	4,569	22.8	
Total		61,822	11,664	266	55	11,986	11.2	8,730	19.4	
1995	Security Cove	6,702 ^a	1,292	0	0	1,292	12.3	956	19.3	
	Goodnews Bay	4,219 ^a	1,051	0	3	1,054	13.5	848	25.0	
	Cape Avinof	3,627 ^a	485	0	0	485	12.5	363	13.4	
	Nelson Island	7,754	1,113	0	0	1,113	10.6	710	14.3	
	Nunivak Island	4,579 ^a	33	7	0	41	11.0	22	0.9	
	Cape Romanzof	5,000 ^a	541	0	0	541	10.1	328	10.8	
	Norton Sound	37,779	6,647	116	10	6,773	10.4	4,206	17.9	
Total		69,660	11,162	123	13	11,299	11.0	7,433	16.2	
1994	Security Cove ^b	7,638 ^a	-	-	-	-	-	-	-	
	Goodnews Bay	5,679 ^a	1,061	0	1	1,062	12.3	391	18.7	
	Cape Avinof	2,827 ^a	427	0	0	427	12.2	156	15.1	
	Nelson Island	5,564	713	4	0	717	11.0	235	12.9	
	Nunivak Island	4,921	14	0	0	14	8.6	4	0.3	
	Cape Romanzof	5,000 ^a	456	0	0	456	9.2	124	9.1	
	Norton Sound	37,829	958	2	0	960	10.3	271	2.5	
Total		69,458	3,629	6	1	3,636	11.1	1,181	5.2	
1993	Security Cove	6,995	5	0	0	5	12.8	2	0.1	
	Goodnews Bay	6,211	945	9	0	954	10.3	293	15.4	
	Cape Avinof	2,837 ^a	206	9	0	215	12.0	75	7.6	
	Nelson Island	4,944	613	52	74	739	10.6	198	14.9	
	Nunivak Island ^b	5,176	-	-	-	-	-	-	-	
	Cape Romanzof	4,000 ^a	371	0	0	372	9.6	110	9.3	
	Norton Sound	46,549	4,713	321	45	5,079	9.9	1,411	10.9	
Total		76,712	6,853	391	119	7,363	10.1	2,089	9.6	
1992	Security Cove	7,773	697	127	10	834	9.2	285	10.7	
	Goodnews Bay	5,572	711	29	0	740	9.5	286	13.3	
	Cape Avinof	3,446	442	9	0	451	9.9	178	13.1	
	Nelson Island	5,275	188	52	6	246	8.3	78	4.7	
	Nunivak Island	5,703	7	20	0	27	8.5	4	0.5	
	Cape Romanzof	4,500 ^a	516	14	0	530	8.0	159	11.8	
	Norton Sound ^b	57,974	-	-	-	-	-	-	-	
Total		90,243	2,561	251	16	2,828	9.1	990	3.1^f	

a Inseason biomass estimate from poor aerial survey, therefore projected biomass or some other method of estimating biomass was used.

b No commercial fishery.

c Includes values from sac-roe fishery only, does not include directed bait, or kelp fisheries values.

d Includes 200 tons from the purse seine catch associated with an aerial survey calibration study.

e Includes estimated value of \$25,000 for the purse seine catch associated with an aerial survey calibration study.

f Total exploitation rate for fishing districts which had a commercial fishery in 1992 is 8.8%.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1992-1999.

Year	District	Number of Buyers	Number of Fishermen		
			Gillnet	Beach Seine ^a	Totals
1999	Security Cove	8	87	-	-
	Goodnews Bay	5	94	-	-
	Cape Avinof	3	117	-	-
	Nelson Island	4	94	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	1	57	-	-
	Norton Sound	4	119	0	122 ^b
1998	Security Cove	9	78	-	-
	Goodnews Bay	2	84	-	-
	Cape Avinof	2	109	-	-
	Nelson Island	2	86	-	-
	Nunivak Island	1	7	-	8 ^c
	Cape Romanzof	1	41	-	-
	Norton Sound	2	35	0	47 ^d
1997	Security Cove	14	222	-	-
	Goodnews Bay	3	139	-	-
	Cape Avinof	2	145	-	-
	Nelson Island	3	105	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	3	65	-	-
	Norton Sound	9	214	6	220
1996	Security Cove	14	326	-	-
	Goodnews Bay	5	182	-	-
	Cape Avinof	2	161	-	-
	Nelson Island	3	109	-	-
	Nunivak Island	2	24	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	10	281	6	287
1995	Security Cove	12	106	-	-
	Goodnews Bay	4	127	-	-
	Cape Avinof	2	93	-	-
	Nelson Island	4	100	-	-
	Nunivak Island	2	13	-	-
	Cape Romanzof	2	49	-	-
	Norton Sound	6	209	6	215
1994	Security Cove	0	0	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	85	-	-
	Nelson Island	3	104	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	2	55	-	-
	Norton Sound	7	212	3	215
1993	Security Cove	1	9	-	-
	Goodnews Bay	3	63	-	-
	Cape Avinof	1	97	-	-
	Nelson Island	1	73	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	2	41	-	-
	Norton Sound	6	256	7	263
1992	Security Cove	6	58	-	-
	Goodnews Bay	3	78	-	-
	Cape Avinof	2	121	-	-
	Nelson Island	3	85	-	-
	Nunivak Island	1	14	-	-
	Cape Romanzof	2	73	-	-
	Norton Sound	0	0	-	-

a Gear prohibited in all districts except Norton Sound and Port Clarence.

b Includes 119 gillnet fishermen, 1 bait fisherman and 2 kelp fishermen.

c Includes 7 gillnet fishermen and 1 seine fisherman.

d Includes 35 gillnet fishermen, 1 bait fisherman and 11 kelp fishermen.

Table 4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1978-1999.^a

Village	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Nelson Island																						
Tununak	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32	45	42	30	25.8	-	-	-
Umkumiut	11	8	3	10	0	-	-	-	-	ε	ε	ε	ε	ε	ε	-	-	-	-	-	-	-
Toksook Bay	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43	23	53	46	41.5	-	-	-
Nightmute	-	-	-	-	-	-	-	3 ^b	21	15	16	15	18	8	10	9	13	13	16.2	-	-	-
Newtok	-	-	-	-	-	-	-	7 ^b	13	10	12	10	8	1	7	6	9	9	11.5	-	-	-
Total	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117	98	95	-	-	-
No. Fishing Families	83	54	70	93	65	43	-	65 ^b	72 ^b	96	104	^b	100	85	97	89	-	91	96	-	-	-
Nunivak Island																						
Mekoryuk	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4	2	-	-	-	-	-	-
No. Fishing Families	-	-	-	-	-	-	-	11	6 ^b	-	-	-	19	20	17	16	-	-	-	-	-	-
Other Kuskokwim Delta																						
Chefornak	-	-	-	-	-	-	-	13 ^b	-	14	-	-	-	-	-	-	-	-	-	-	-	-
Kipnuk	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-	-	-	-	-	-	-
Kongiganak	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kwigillingok	-	8	13	-	13	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	8	13	-	13	-	-	30	2	28	-	-	-	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	22	19	-	21	-	-	55 ^b	12 ^b	49	-	-	-	-	-	-	-	-	-	-	-	-
Yukon Delta																						
Scammon Bay	1	6	3	8	4	3	4	2	2	1	2	1	2	1	1	3	1	1	1	1	<1	6.0
Chevak	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2	1	<1	<1	<1	2.3
Hooper Bay	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3	4	2	2	1	4.2
Total	5	11	11	14	11	9	11	8	6	3	7	3	8	3	4	5	6	6	3	3	2	12.5
No. Fishing Families	30	84	61	45	43	37	47	44	40	23	32	24	32	18	30	42	48	42	29	34	15	67

^a Subsistence survey results are believed to accurately reflect harvest trends however, reported catches reflect minimum figures since all fishermen cannot be contacted.

^b Fishing families were not interviewed or only a portion of fishing families were interviewed as catch was enumerated while on drying racks.

^c Umkumiut effort included with Tununak.

Table 5. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-1999.

Year	Herring (st)								Total Biomass
	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof ^a	Norton Sound	Port Clarence	
1978	1,323	441	-	5,952	805	2,976	5,291	-	16,788
1979	21,495	7,385	-	5,952	-	2,976	7,716	-	45,524
1980	1,213	1,213	-	5,952	-	2,976	8,377	-	19,731
1981	8,267	4,299	-	3,968	19	4,850	22,360	-	44,331
1982	5,071	2,646	-	3,968	-	4,850	19,403	-	33,951
1983	6,393	3,197	-	7,275	7,606	5,512	26,841	-	58,092
1984	5,071	4,079	-	11,023	6,695	6,063	21,475	-	56,079
1985	4,900	4,300	2,000	9,500 ^b	5,700 ^b	7,000	20,000	-	51,400
1986	3,700 ^b	3,000 ^b	-	7,300 ^b	6,000	7,500	28,100	-	55,600
1987	2,300 ^b	2,000 ^b	1,225	8,100	4,400 ^b	7,200	32,370	932	57,332
1988	4,906	4,479	4,108	7,152	2,800 ^b	6,600	33,924	788	64,757
1989	2,830	4,040	2,780 ^b	3,320	620	4,400	25,981	-	43,970
1990	2,650	2,577	2,020 ^b	2,705	422	4,500	39,384	-	54,258
1991	4,434	4,387	2,083	2,385	3,903	4,500	42,854	-	64,546
1992	7,773	5,572	3,446	5,275	5,703	4,500	57,974	1,652	91,895
1993	6,995	6,211	2,837 ^b	4,944	5,176	4,000	46,549	822	77,534
1994	7,638 ^b	5,679 ^b	2,827 ^b	5,564	4,921	5,000	37,829	92	69,550
1995	6,702 ^b	4,219 ^b	3,627 ^b	7,754	4,579 ^b	5,000	37,779	-	69,660
1996	6,867	6,315	4,500 ^b	6,638 ^b	4,195 ^b	6,000	27,307 ^b	-	61,822
1997	4,640 ^b	4,752 ^b	4,600 ^b	7,900 ^b	3,801 ^b	5,000 ^c	47,791	-	78,484
1998	4,017 ^b	4,064 ^b	4,287 ^b	7,136 ^b	3,778 ^b	4,500 ^d	52,033	-	79,815
1999	5,261	6,896	3,555 ^b	6,655	3,319 ^b	3,800 ^e	34,314	-	63,800

^a Biomass estimate based on limited aerial survey information, spawn deposition, age composition, and CPUE from commercial and test fisheries.

^b Unacceptable aerial survey conditions for estimating herring biomass, therefore projected biomass or some other method of estimating biomass was used.

^c Biomass listed for Cape Romanzof is midpoint for estimated range of 4,500 to 5,500 tons.

^d Biomass listed for Cape Romanzof is midpoint for estimated range of 4,000 to 5,000 tons.

^e Biomass listed for Cape Romanzof is midpoint for estimated range of 3,300 to 4,300 tons.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1999.

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)	
Security Cove		Gillnet	1	5/25	1500-1700	2.0	333.6	
			2	5/26	0400-0700	3.0	498.4	
			3	5/26	1600-1900	4.0	240.2	
			Total			9.0	1,072.2	
Goodnews Bay		Gillnet	1	5/29	0500-1100	6.0	48.9	
			2	5/29	1700-2300	6.0	61.0	
			3	5/30	0600-1200	6.0	5.0	
			4	5/30	1800-2400	6.0	97.6	
			5	5/31	0700-1500	8.0	496.2	
			6	5/31-6/01	1900-0200	7.0	260.0	
			7	6/01	0700-1400	7.0	331.8	
			8	6/01	2100-2400	3.0	65.4	
Total			49.0	1365.9				
Cape Avinof		Gillnet	1	6/11	0700-1000	3.0	16.8	
			2	6/11	1800-2400	6.0	27.1	
			3	6/12	0700-1300	6.0	67.9	
			4	6/12-13	1900-0100	6.0	123.3	
			5	6/13	0800-1400	6.0	43.3	
			6	6/13-14	2000-0200	6.0	94.0	
			7	6/14	0800-1400	6.0	40.1	
			8	6/14-15	2100-0300	6.0	87.1	
			9	6/15	0930-1530	6.0	33.5	
Total			51.0	533.1				
Nelson Island		Gillnet	1	6/4	1200-2100	9.0	406.9	
			2	6/7	1600-2200	6.0	421.7	
			3	6/8	1700-2400	7.0	537.5	
Total			22.0	1,366.1				
Nunivak Island		Gillnet	No Commercial Opening					
Cape Romanzof		Gillnet	1	6/5	0630-0800	1.5	64.5	
			2	6/7	0630-0930	3.0	103.5	
			3	6/7	1930-2130	2.0	107.8	
			4	6/9	2100-2230	1.5	176.8	
			5	6/12-13	2230-0030	2.0	67.1	
			6	6/13	1300-1400	1.0	0.8	
			7	6/13-14	2330-0200	2.5	12.4	
Total			13.5	532.9				
Norton Sound	1,2,3	Gillnet	1	6/14	0500-1300	8.0	349.5	
			2	6/15	0700-1100	4.0	183.0	
			3	6/16	0700-1900	12.0	481.3	
			4	6/17	0800-2000	12.0	625.3	
			5	6/18	0800-0000	16.0	491.2	
			6	6/19	0800-2200	14.0	89.9	
			7	6/20	0800-2200	14.0	355.6	
			8	6/21	0800-2200	14.0	149.6	
			9	6/22	0800-1500	7.0	21.5	
Waste						5.0		
					101.0	2,751.8		

-continued-

Table 6. (p. 2 of 2)

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Norton Sound	2,3	Beach Seine	1	6/18	1300-1700	4.0	0.0
	1		2	6/21	1300-1700	4.0	0.0
						8.0	0.0
	7	Gillnet - Bait	1	6/16-30	continuous	342.0	8.3
	1,2,3,4,5,6	Open Pound	1	5/18-6/28	continuous		3.7 ^a
	1	Wild Kelp	1	5/28	1800-0400	4.0	0.0
				Total		455.0	2,760.1 ^b

^a Product weight

^b Does not include spawn on kelp product weight.

Table 7. Projections of Pacific herring spawning biomass and harvest guideline for commercial fishing districts in the northeastern Bering Sea, Alaska, 2000.

District	Threshold	Projected ^a Biomass (st)	Exploitation Rate (%)	Harvest (st) ^a Guideline
Security Cove	1,200	3,622	20	724
Goodnews Bay	1,200	4,665	20	933
Cape Avinof	500	2,868	15	430
Nelson Island	3,000	4,672	16	734 ^b
Nunivak Island	1,500	2,823	20	565
Cape Romanzof	1,500	2,567 ^c	20	513 ^c
Norton Sound	7,000	26,924	20	5,385
Port Clarence	-	-	-	165 ^d
Totals		48,141		9,450

a Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.

b Nelson Island commercial harvest is 20% of projected biomass minus 200 st for subsistence harvest.

c Projection from midpoint of 1999 biomass estimate of 3,300 to 4,300 tons which was based on spawn deposition, age composition, and CPUE from commercial and test fisheries. Allowable harvest will range from 463 to 563 tons based on inseason indicators of abundance.

d Harvest guideline of 165 st (150 mt).

Table 8. Herring harvest by gear type and subdistrict, Norton Sound District, 1982-1999.

		NORTON SOUND HERRING CATCHES																	
		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GILLNET HARVEST (tons)																			
St. Michael		2,062	434	-	1,538	2,560	2,214	3,215	2,927	4,491	-	-	2,288	249	2,359	3,074	1,575	1,543	285
Unalakleet		946	1,264	-	95	-	-	42	10	618	731	-	120	12	374	-	20	-	324
Cape Denbigh		925	2,692	3,244	1,599	2,420	1,545	1,211	1,414	923	4,419	-	1,659	619	1,467	2,507	1,864	1,081	2,138
Elim		-	65	-	147	-	-	6	-	-	-	-	225	41	1,774	-	-	-	-
Golovin		-	85	-	-	-	-	-	-	-	-	-	-	-	191	-	-	-	-
Nome																			8
Total ^a		3,933	4,540	3,244	3,379	4,980	3,759	4,474	4,351	6,032	5,150	^b	4,291	921	6,166	5,581	3,459	2,632	2,755
SEINE HARVEST (tons)																			
St. Michael (beach)		-	-	-	-	-	4	45	329	6	-	-	-	1	-	-	472	-	-
Unalakleet (beach)		-	-	-	93	-	-	58	50	332	149	-	467	24	230	111	41	-	-
Cape Denbigh (beach)		-	41	327	76	30	293	96	11	9	373	-	222	15	57	325	-	-	-
Elim (beach)		-	-	-	-	185	-	-	-	-	-	-	54	-	334	153	-	-	-
Cape Denbigh (purse)		-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-	-	-
Total ^a		0	41	327	169	215	323	198	390	347	522	^b	743	40	621	589	513	0	0
TOTAL HARVEST (tons) ^a		3,933	4,581	3,571	3,548	5,195	4,082	4,672	4,741	6,380	5,672	0	5,034	961	6,787	6,170	3,972	2,632	2,755
Percent of total harvest																			
Gillnet Harvest		100	99.1	90.8	95.2	95.9	92.1	95.8	91.8	94.6	90.8		85.2	95.9	90.9	90.5	87.1	100	100
Seine Harvest		0	0.9	9.2	4.8	4.1	7.9	4.2	8.2	5.4	9.2		14.8	4.1	9.1	9.5	12.9	0	0

a Totals do not include waste.

b No commercial fishery.



Figure 1. Commercial herring fishing districts within the Arctic-Yukon -Kuskokwim Region of the northeastern Bering Sea, Alaska.

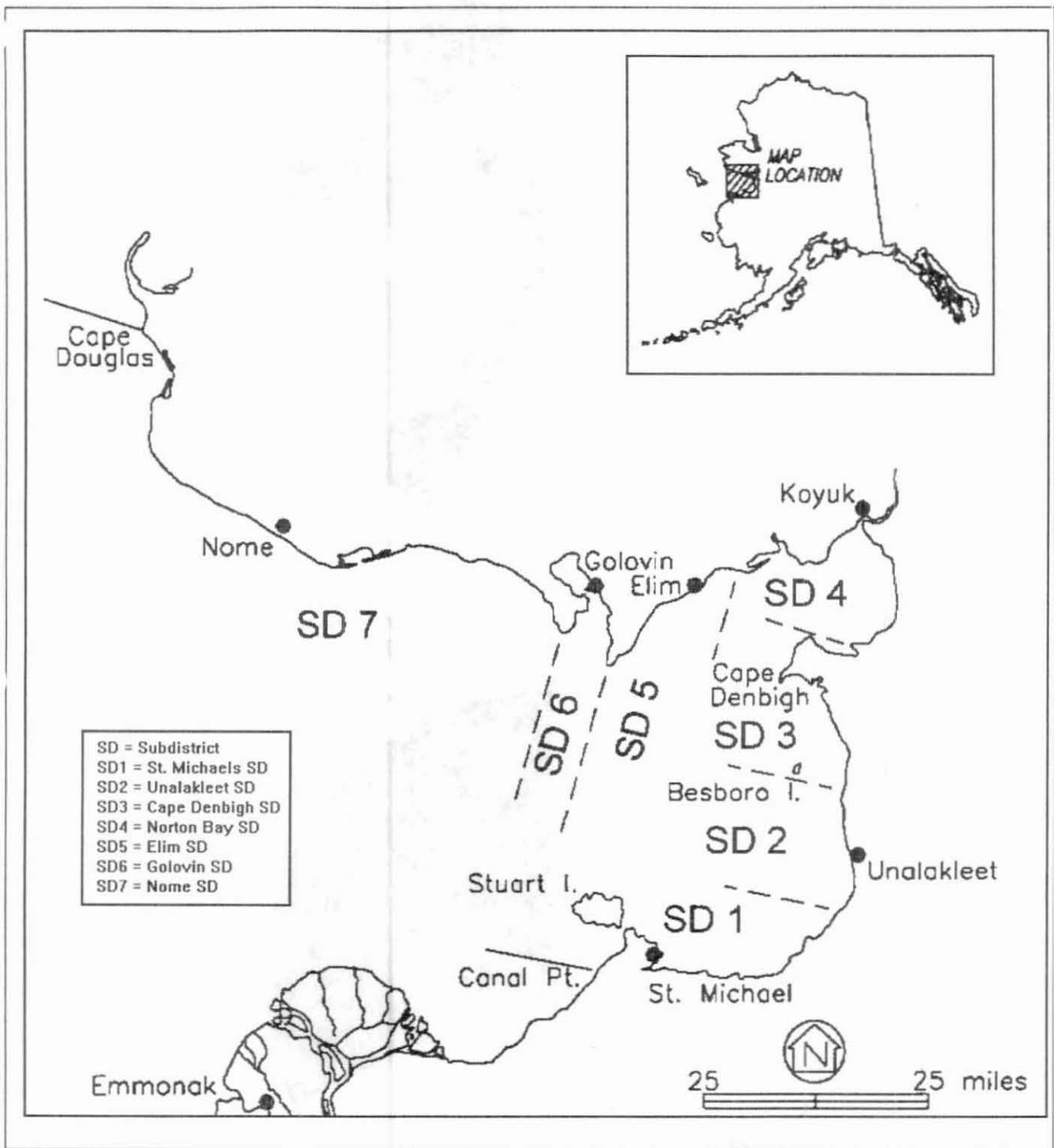


Figure 2. Norton Sound commercial herring subdistricts.

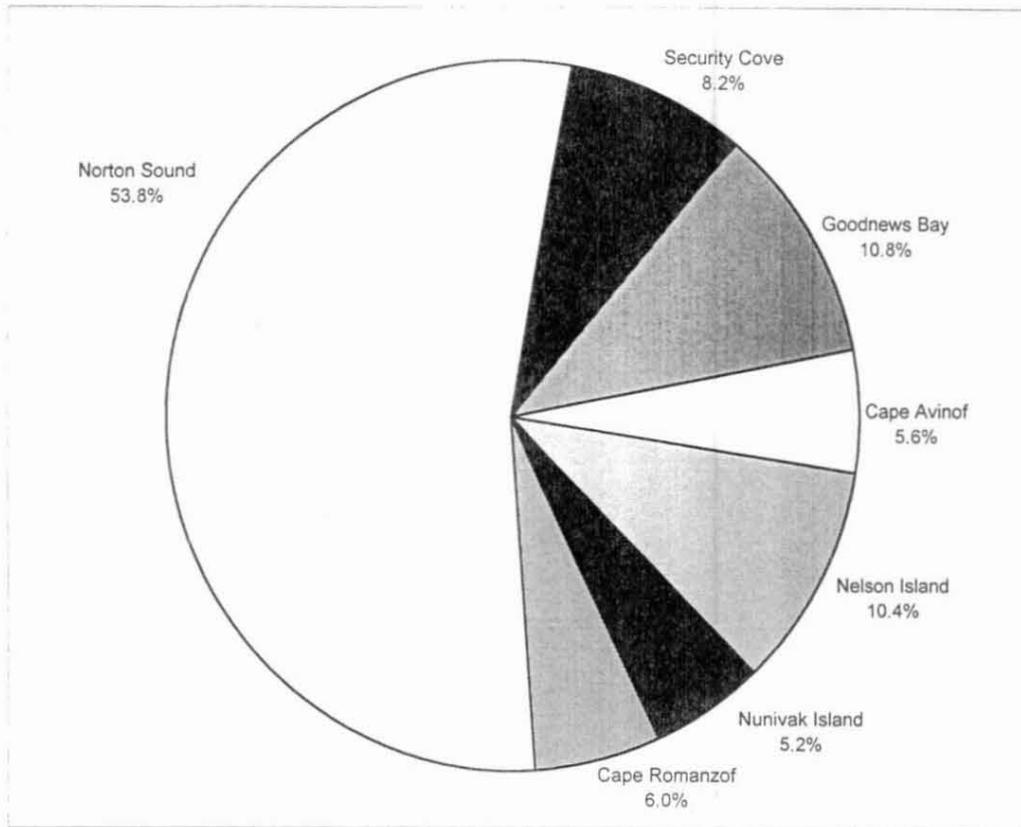


Figure 3. Pacific herring run biomass distribution by commercial fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1999.

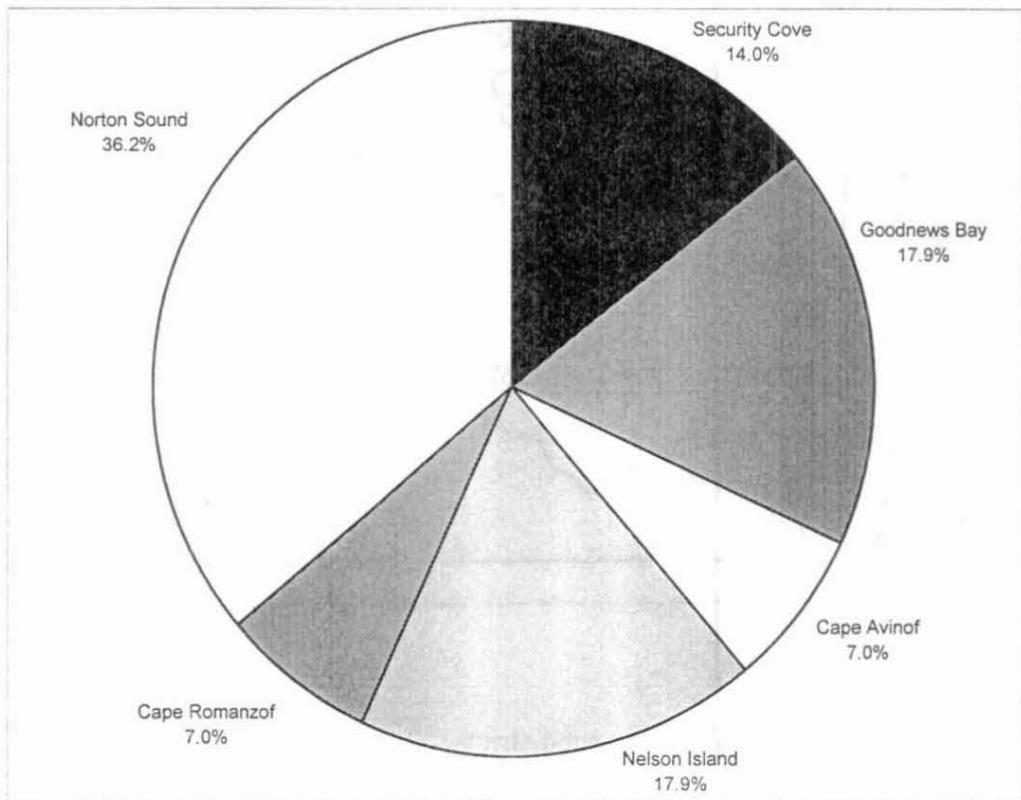


Figure 4. Pacific herring commercial harvest distribution by fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1999.

Total Run Biomass (tons)

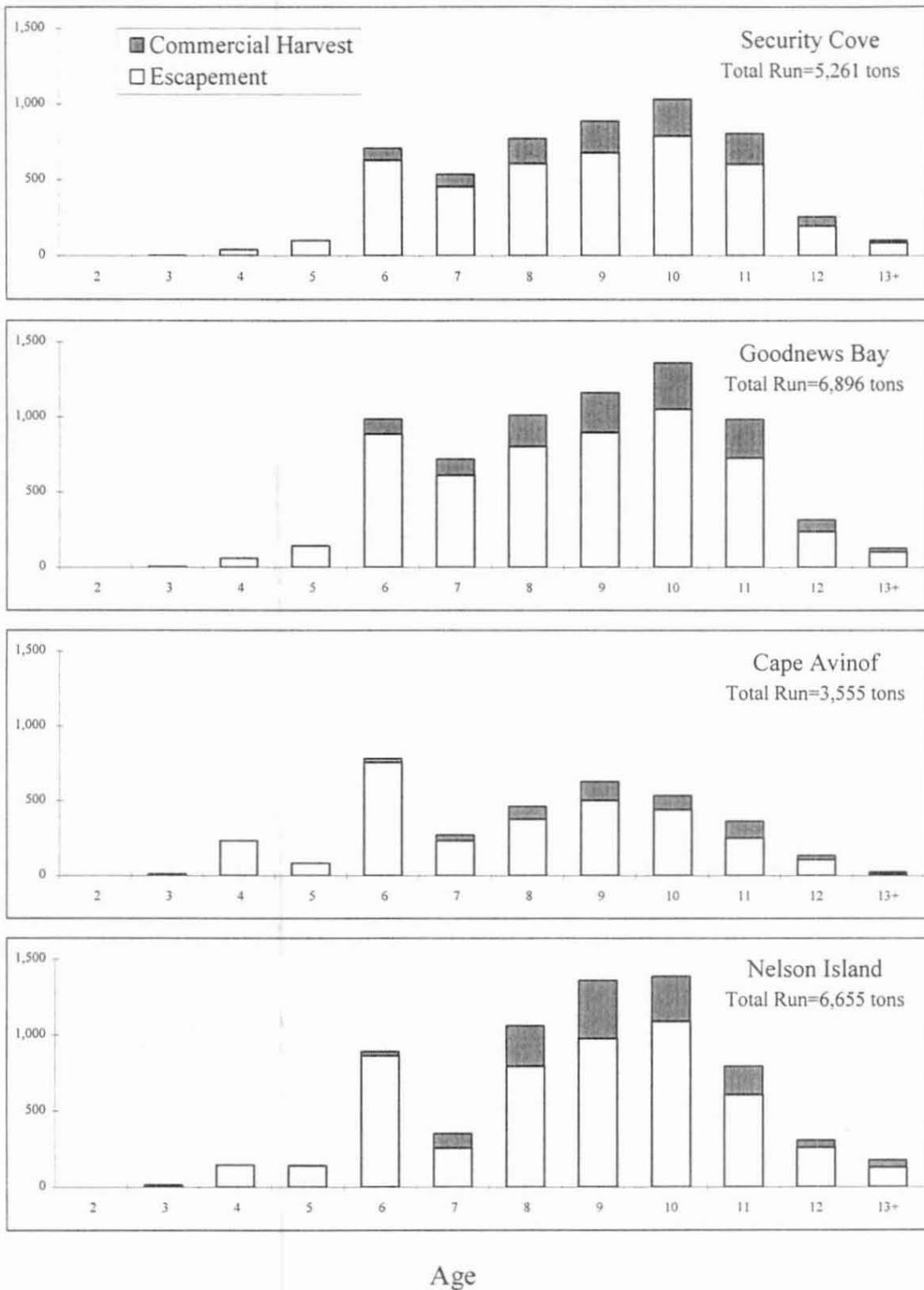


Figure 5. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999.

Total Run Biomass (tons)

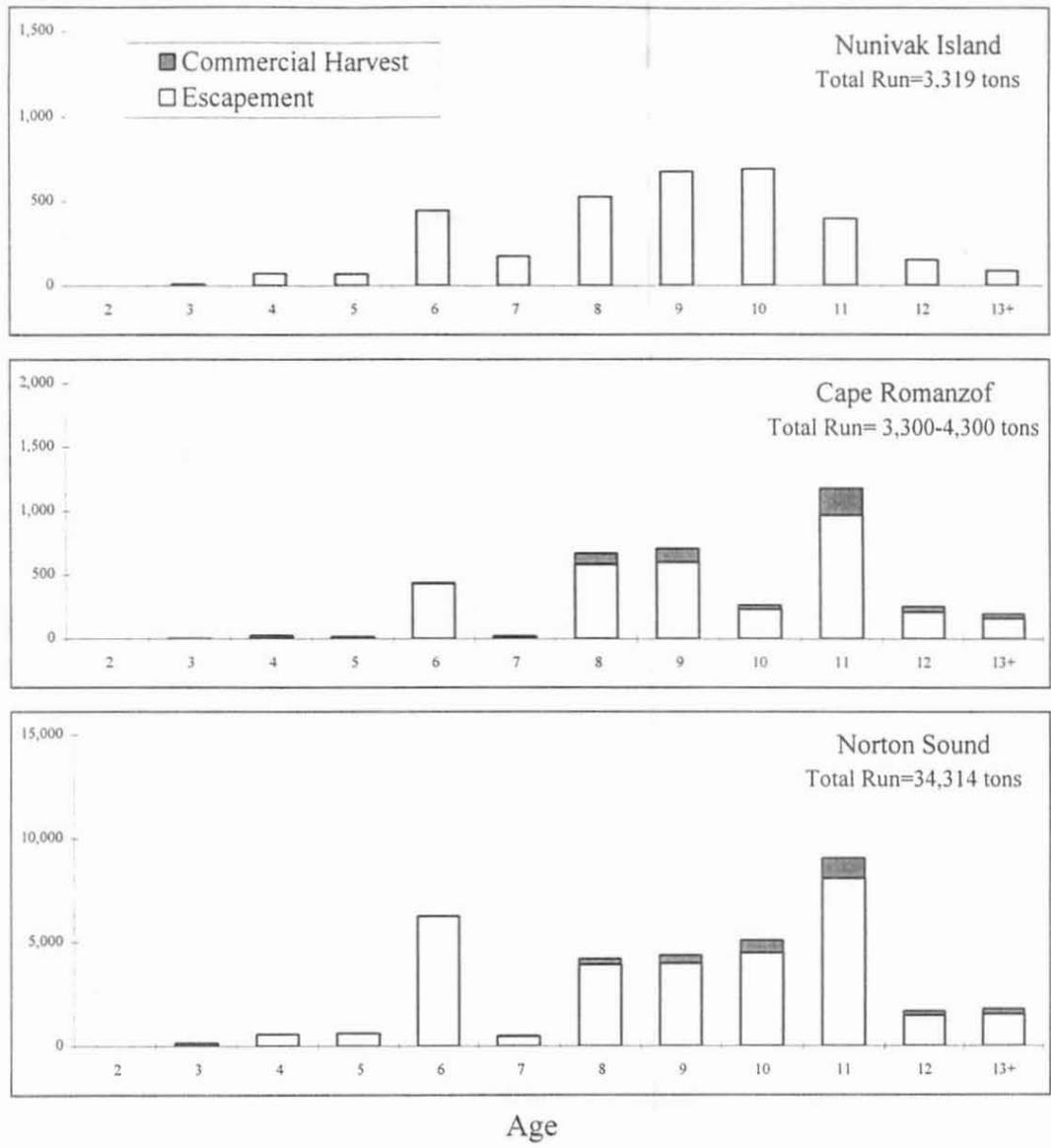


Figure 6. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Nunivak Island, Cape Romanzof, and Norton Sound Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999.

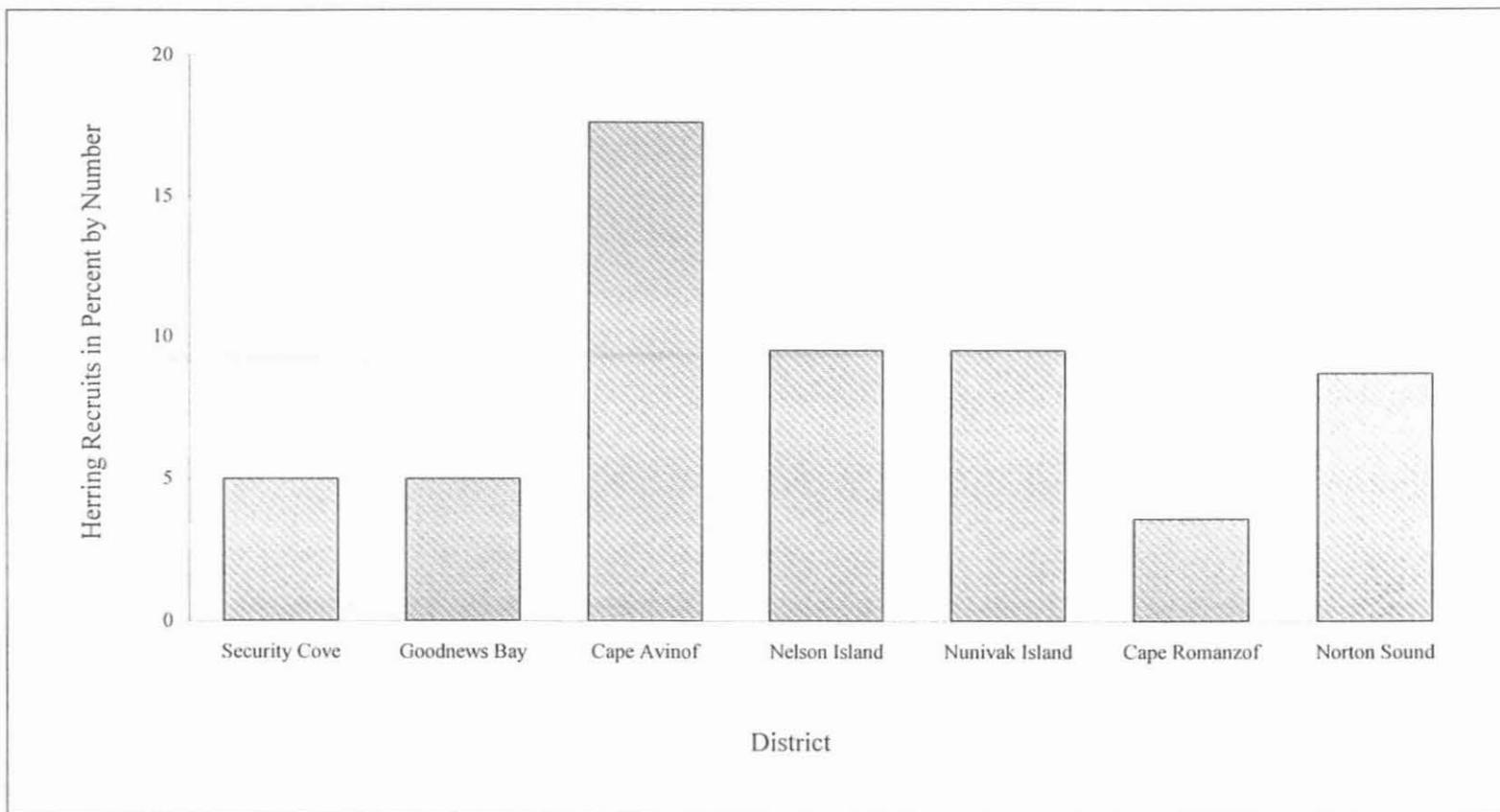


Figure 7. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1999.